MEMORANDUM

DEPARTMENT OF TRANSPORTATION
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Date: July 17, 2000

To: CDOT & Consultant Design & Construction Personnel

From: S. W. Horton, Bridge Branch Manager

Subject: Post-Tensioning Anchor Systems

Recently, due to construction failures, Staff Bridge changed its specifications and worksheets on post-tensioning anchors. Projects with post-tensioning are in progress that have plans and specifications that predate these changes. To prevent problems with these legacy projects we have some additional direction for the checkers of shop drawings of post-tensioning anchorages and anchor zones:

The use of composite anchors is discouraged (anchors with thin metal confining a precast cementatious fill). We have had a failure of one of these anchors in a relatively non-ductile mode. The failure seems to have involved fractures of the casting at a flaw and at tapped holes, and seems to have involved the failure of the back of the grout gallery. There also appeared to be a prior bond failure of the cementatious fill to the casting. The failure also involved a construction joint passing through the zone of highly compressed concrete behind this anchorage. This joint split apart at this anchor and at the other anchors that it passed under.

If composite anchors have already been approved or delivered to a project, unless they are already cast in the concrete, discuss with the project engineer the possibility of changing them to another type. If they are already cast in the concrete but not yet post-tensioned, call Staff Bridge. We will help evaluate the risk of using the anchors for the particular situation. The risk of failure is not an issue of public safety for bonded tendons, but a possible risk of substantial damage to the anchorage area and a prestress loss, occurring in the period of time between the jacking of the tendon and perhaps a day or so after grouting. When needed, repairs can be expensive and difficult.

We present the following for evaluating composite anchors that may already be cast in the concrete and as a quick guide for evaluating shop plans on all anchor systems. Please contact Staff Bridge about any anchorage that does not meet these simplified rules:

> Do not allow construction joints to pass through the concrete that the anchorage bears on, or through the concrete confined by any spirals, or through the concrete that the concrete confined by a spiral bears on, for a distance of approximately 1/2 of the spiral diameter ahead of the spiral.
>
> Assure that any anchor has either of the following. The 0.7f'ci can be relaxed to as high as 0.9f'ci if a minimum of 4" of cover and clear spacing is maintained around the anchor and any associated spiral, and f'ci is not high (over 4500 psi):
>
> 1. Sufficiently low compressive stresses on the concrete (<0.7f'ci) that a bursting or splitting failure is unlikely to occur.

2. A spiral concrete reinforcement confining the concrete area under the anchorage, with sufficient pitch to allow good concrete consolidation (2" minimum clear between turns). This spiral should confine a sufficiently large cross section of concrete such that the average compressive stress on that confined concrete and the bearing stress on the concrete ahead of the confined concrete will be below 0.7f'ci. This spiral should have sufficient steel area that the spiral can resist a bursting force of 0.3*Pu at fy of the spiral reinforcing. Take Pu as 1.33 of Pj. The 0.3 is the typical maximum ratio of bursting force to compressive force. Smaller diameter or weaker spirals are at increasing risk of not providing the necessary confinement to preclude the need for the full sized bearing plate in 1. above, especially if there are complicating factors such as a localized area of low concrete strength, poor alignment or geometry, poor workmanship, a poorly located construction joint, or concrete cracking for any reason.

An example: f'ci = 3.5 ksi, Pj = 835kips. Therefore the bearing area on the concrete needs to be 835/(0.7*3.5)=341 sq. in., or the outer spiral diameter needs to be 21", (Square root of (341/0.7854)), with 1.33*0.3*835/60ksi = 5.6 sq. in., say 7 turns #6 at 3" pitch. Area of spiral = 7 turns * .44 sq. in per bar * 2 bar cross sections per turn = 6.16 sq. in. Add one half turn at each end for development = 8 turns.

These policy changes are effective immediately for all projects currently in progress.

SWH/PKP/MLM/mlm

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